



Principles of Antimicrobial

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2nd stage

Medical microbiology I

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In previous lecture

- Sterilization

Physical & Chemical methods

In this lecture

- Principles of Antimicrobial

Lecture topics

- **Chemotherapy**
- **Classification of Antimicrobials**
- **Mechanism of action**
- **Antibiotic resistance**
- **Mechanisms of resistance gene transfer**
- **Example on mechanisms of resistance**
- **Antimicrobial susceptibility test**

Chemotherapy

Drugs used in treating infectious diseases and cancer

- Infectious diseases are a major cause of death worldwide(Kozier,et al. 2008)
- The control of the spread of microbes & the protection of people from communicable diseases and infections are carried out on the international, national community , and individual levels

What are Antimicrobials ?

- ❖ **Antimicrobials are drugs that destroy microbes, prevent their multiplication or growth, or prevent their pathogenic action**
- ✓ Differ in their physical, chemical, and pharmacological properties
- ✓ Differ in antibacterial spectrum of activity
- ✓ Differ in their mechanism of action

What is a good antibiotic?

- ✓ Soluble , not protein bound
- ✓ Stable and unaltered in tissues
- ✓ Good therapeutic Index (TI)= toxic dose/ therapeutic dose
- ✓ Not allergic

Classification of Antimicrobials

A- According to source

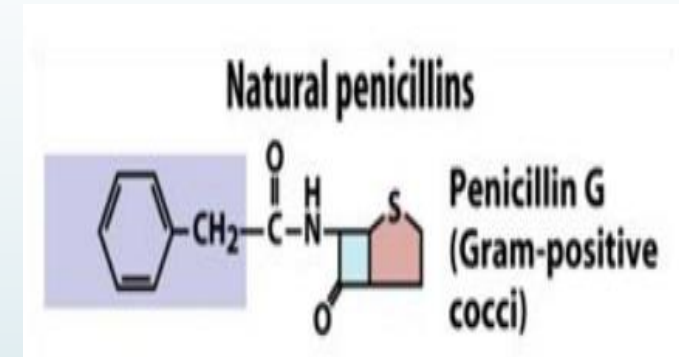
B- According to mechanism of action

C- According to antimicrobial spectrum

Classification of Antimicrobials

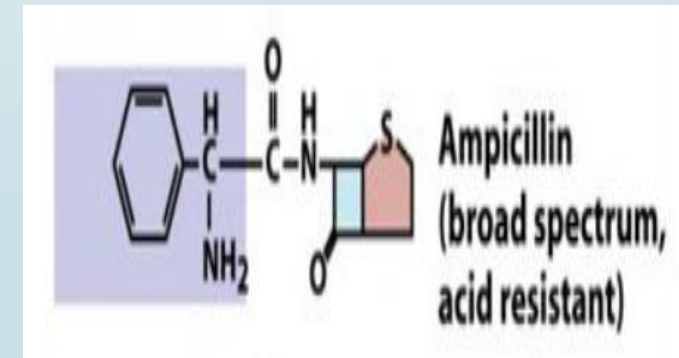
A- According to source

1- Natural compounds: e.g. penicillin, chloramphenicol



2- Synthetic compounds: e.g. sulfonamides, quinolones

3- Semisynthetic compounds :
e.g. ampicillin



Classification of Antimicrobials

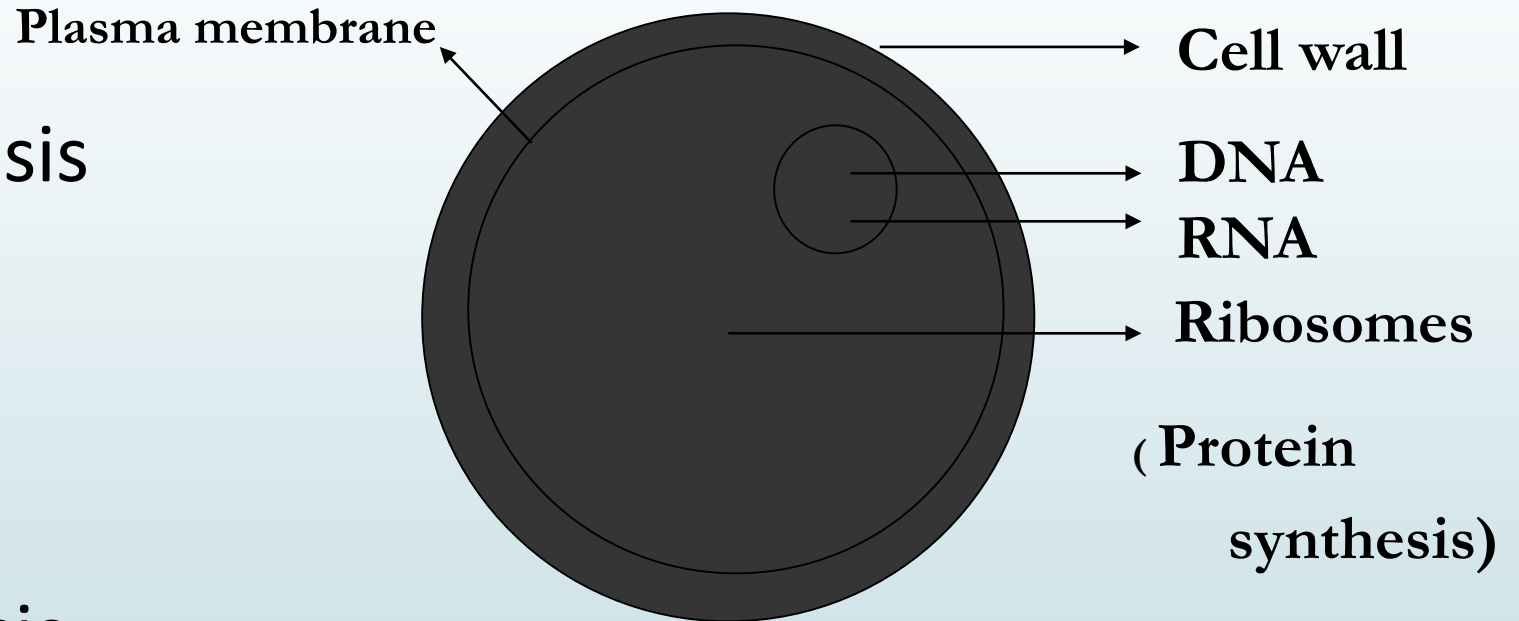
B- According to mechanism of action

1- Inhibit cell wall synthesis

- Penicillins
- Cephalosporins
- Carbapenems
- Vancomycin

2- Inhibit protein synthesis

- Chloramphenicol
- Tetracyclines
- Clindamycin



Classification of Antimicrobials

B- According to mechanism of action

3- Inhibit nucleic synthesis

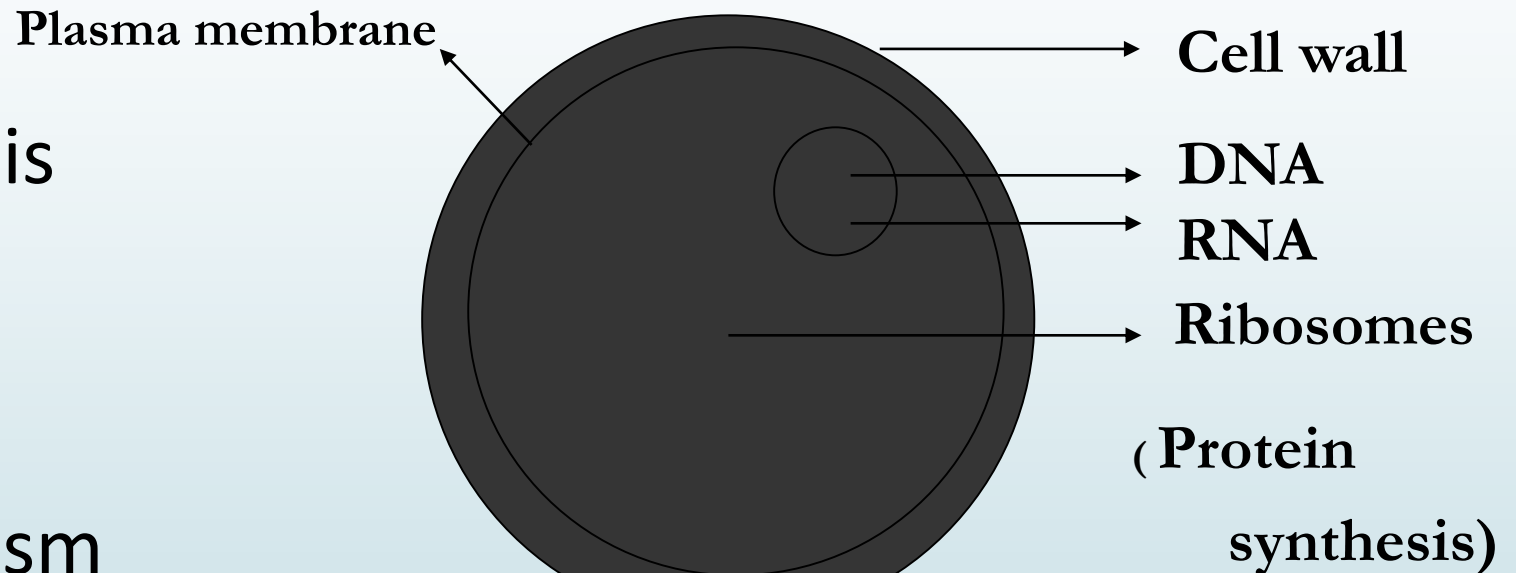
- Rifamycins
- Quinolones

4- Inhibit folate metabolism

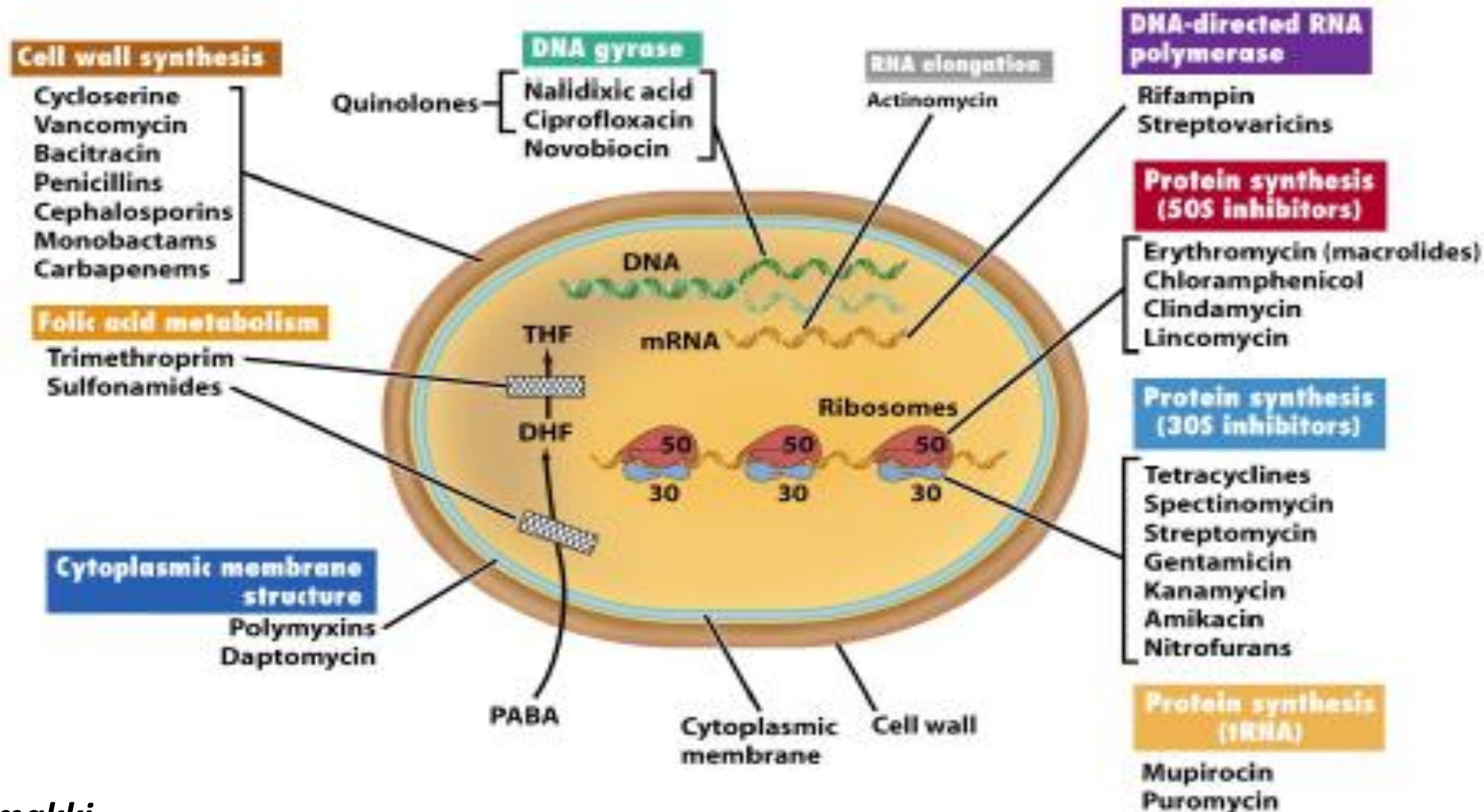
Interference with metabolism of microorganisms

Paraaminobenzic acid (PABA) → Folic acid → Folinic acid

- Sulfonamides
- Trimethoprim



Mechanism of action



Classification of Antimicrobials

C- According to antimicrobial spectrum

1- Narrow spectrum drugs

- Drugs affect mainly Gram +ve bacteria e.g. benzyl penicillin
- Drugs affect mainly Gram -ve bacteria e.g. aminoglycosides

2- Extended spectrum drugs

- Agents that affect Gram +ve and Gram -ve bacteria

3- Broad spectrum drugs

- Agents act on wide range of Gram +ve and Gram -ve bacteria and others (protozoa) e.g. Tetracyclines

Spectrum of Activity

13

Broad spectrum vs Narrow spectrum

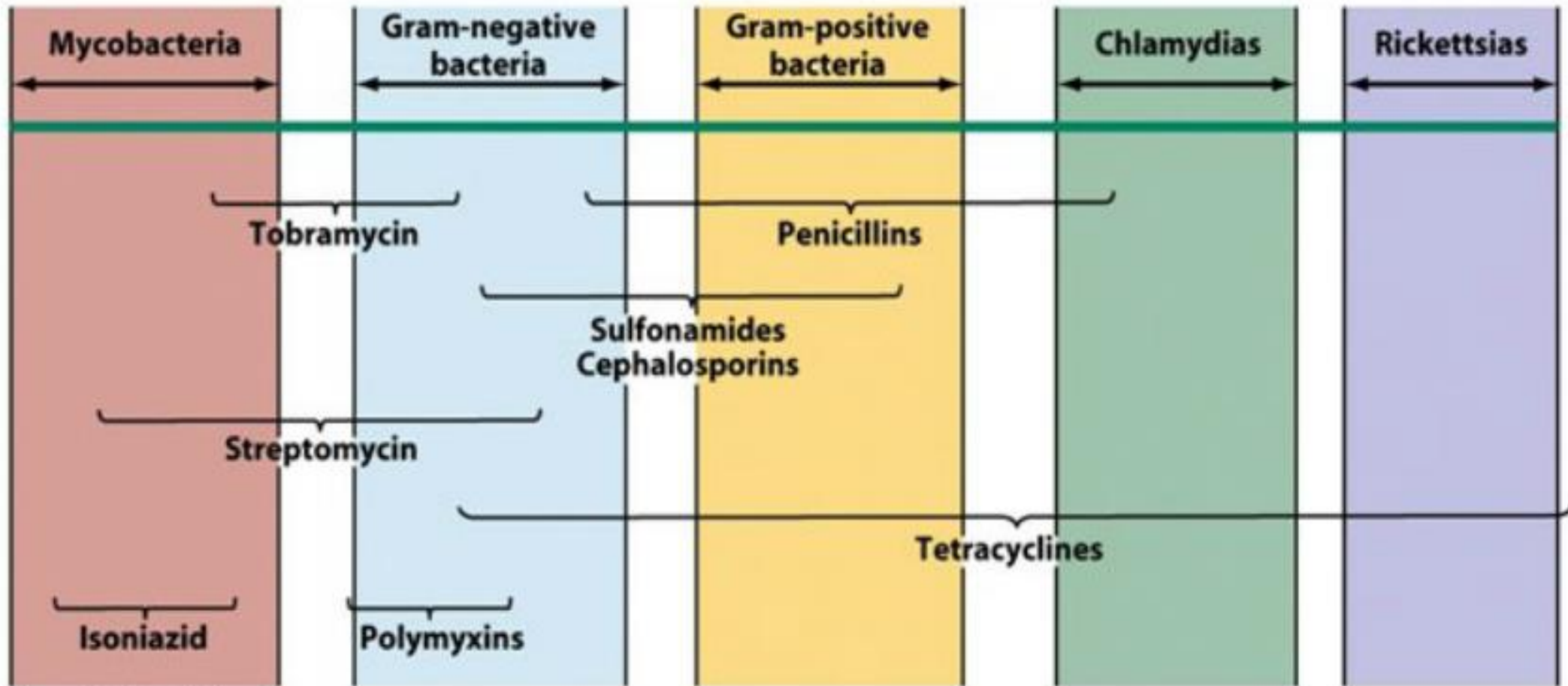


Figure 13-1 Microbiology, 7/e
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Antibiotic resistance

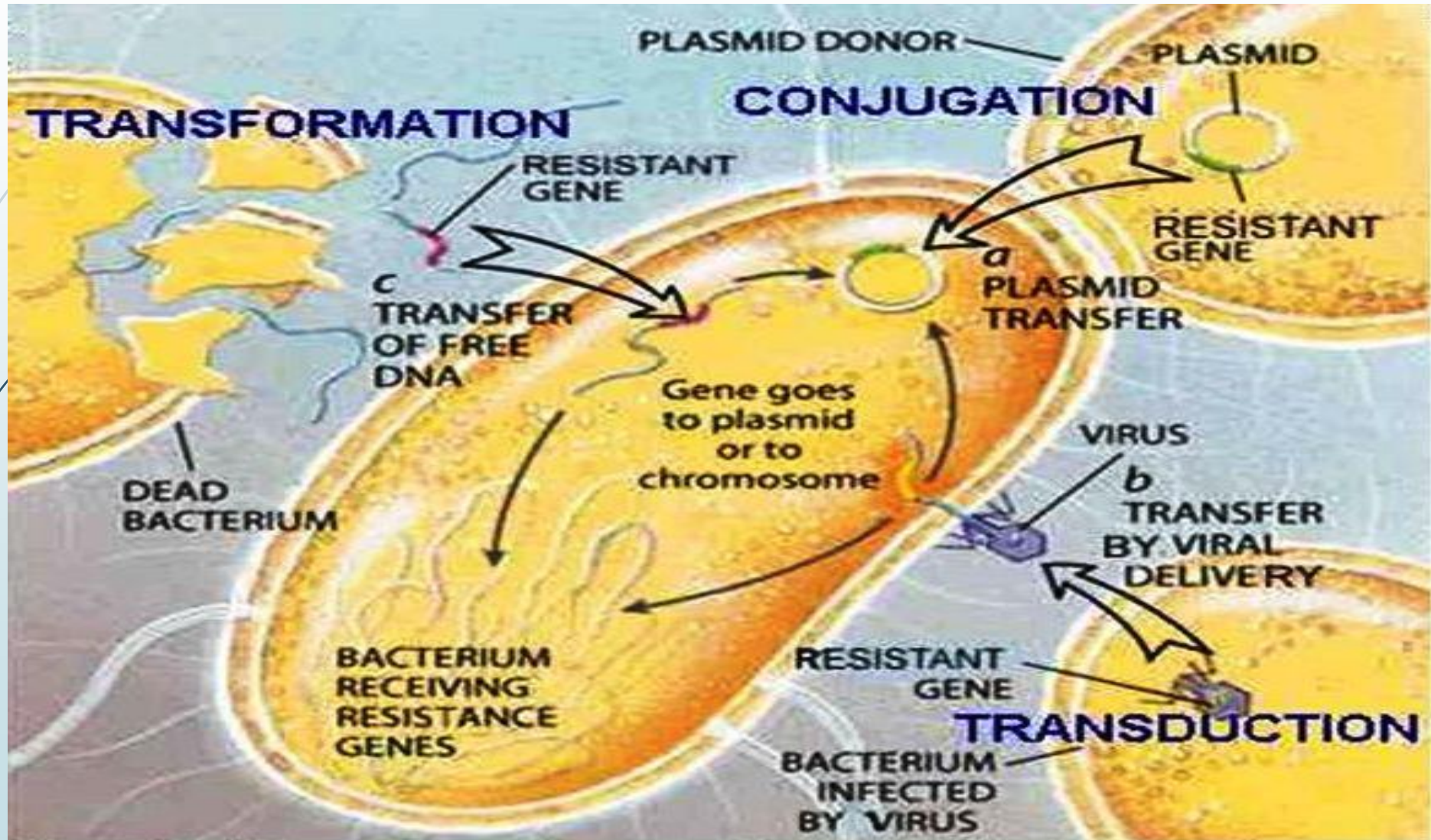
Antimicrobial resistance (AMR or AR) is the ability of a microbe to resist the effects of medication that once could successfully treat the microbe.

I- Innate resistance

- Is a feature of a particular species of bacteria e.g. *Pseudomonas*
- The gene(s) of resistance can be transferred between bacteria by transfer of naked DNA (**Transformation**), by **Conjugation** with direct cell-to-cell transfer of extrachromosomal DNA (plasmids), or through bacteriophage (**Transduction**)

Mechanisms of resistance gene transfer

15

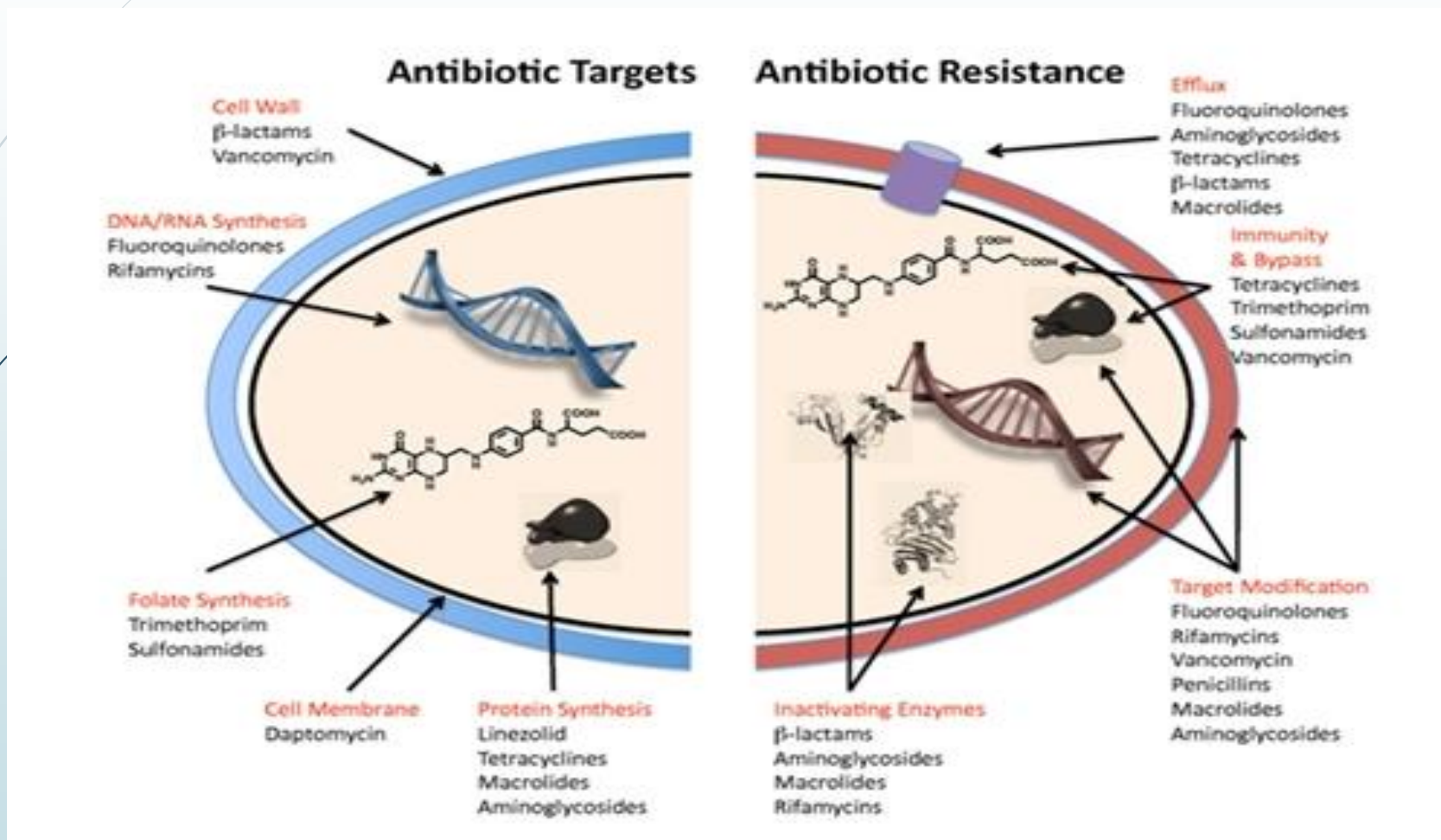


Antibiotic resistance

I- Acquired resistance

- Occurs when bacteria that were sensitive to certain antibiotic become resistant with time
- Mechanisms responsible
 - 1- Production of enzymes that inactivate the drug (e.g. beta lactamase)
 - 2- Alteration of drug binding site (e.g. penicillin binding protein)
 - 3- Reduction in drug uptake by the organism (efflux pump)
 - 4- Development of altered metabolic pathways (e.g.sulfa drugs)

Acquired Bacterial Resistance



Example on mechanisms of resistance

18

- Generating enzymes that inactivate the antibiotic (beta lactamase)
- Changing structure of target site e.g. PBP's (beta lactams and aminoglycosides)
- Preventing cellular accumulation of antibiotic by altering outer membrane proteins or using efflux pumps e.g. G-ve
- Changing the metabolic pathway that is being blocked (sulfa drugs)
- Overproducing the target enzyme or protein to overpower the effects of antibiotics
- Mycoplasma lacks a cell wall making it impervious to penicillin's
- Sulfonamides have no impact on bacteria that obtain their folate from environment

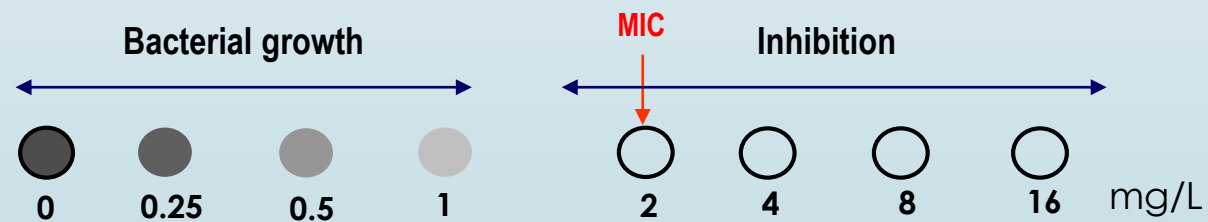
Resistance study

Antimicrobial susceptibility tests:

- ❖ Minimal inhibitory concentration (MIC)
 - The lowest concentration of drug that prevents visible bacterial growth after 24 hours of incubation in a specified growth medium
- 1-Liquid media (dilution)
- 2-Solid media (diffusion)

Antimicrobial susceptibility test

❖ Liquid media (dilution)

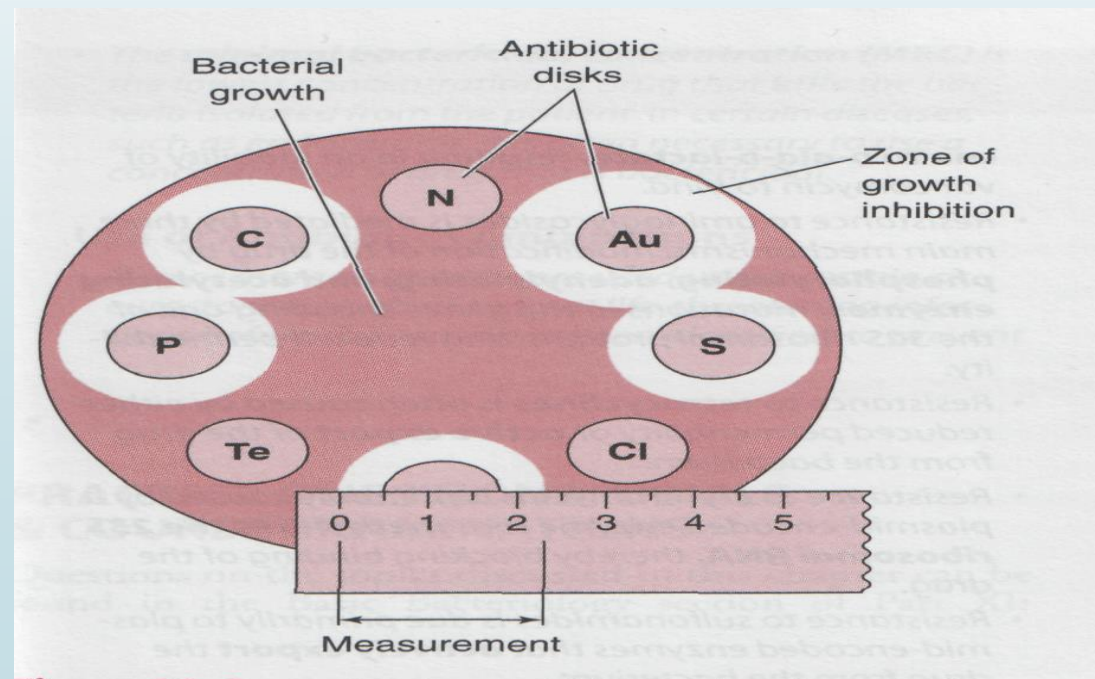


Antimicrobial susceptibility tests

Solid media (diffusion)

-Disk diffusion

- Report organisms(s) and susceptibilities to antimicrobials
- ✓ Susceptible (S)
- ✓ Intermediate (I)
- ✓ Resistant (R)

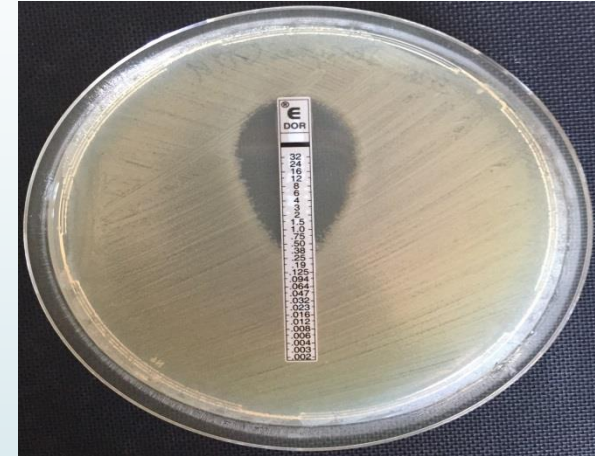


Antimicrobial susceptibility tests

-E-tests

Plastic strips with a predefined gradient of one antibiotic

- ❖ One strip per antibiotic
- ❖ Wide range of antibiotics
- ❖ Easy to use



**Thank you for
your attention**

Any Questions